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Retrograde intubation with a Mini-Trach II kit

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Background: Retrograde intubation has been accepted internationally as a viable alternative for managing the difficult airway. Various techniques have been described to perform this procedure, however, difficulties have arisen on account of problems with suboptimal materials. We therefore describe a retrograde intubation technique using the knife and stiff plastic introducer from a Mini-Trach II set from Portex Ltd (Kent, UK).
Methods: The cricothyroid membrane was identified and using the knife from the mini-trach set, incised longitudinally. The plastic introducer was inserted through the incision and maneuvered out through the mouth providing a guide over which the endotracheal tube was threaded. The technique was evaluated on 20 cadavers and thereafter used in four patients.
Results: Mean intubation time in the 20 cadavers was 6.7 s (range 3–10) from incision to removal of the guide. Also, the technique was used successfully in four patients in whom anterograde attempts failed. In one of these patients the retrograde intubation was life saving.
Conclusion: Retrograde intubation with a stiff curved plastic introducer was rapid and easy in cadavers and in four patients. In emergency situations where conventional intubation fails it may be life saving.

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Key words: Anesthetic techniques: tracheal intubation; intubation tracheal: emergency, retrograde.

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IT is rare that patients die because they can not be intubated nor ventilated (1). Among deaths or serious neurologic damage solely as a result of anesthesia, 7–31% are reported to be associated with tracheal intubation (2). This figure rises to as high as 41% in obstetric patients (2). We, as anesthesiologists, must be prepared to deal with this scenario to the extent that in the event of all available anterograde intubation options failing, we are ready to perform more invasive maneuvers to secure the airway.

Retrograde intubation through the cricothyroid membrane was first described in 1960 (3). Since then its use has been included as a viable alternative in the ASA difficult airway algorithm (4). This technique has been attempted using various makeshift guides including, among others, epidural catheters and central venous line guide wires (5–7). However, as none of these was originally intended nor therefore designed for retrograde intubation, difficulty in their manoeuver arises as a result of the soft nature of their construction. Similarly, none is ideal to guide the tube into the trachea. We therefore investigated using a mini-tracheotomy kit with a stiff curved plastic introducer (Mini-Trach II, Portex Ltd., Kent, UK) for retrograde intubation.

Materials and methods

The technique was evaluated on 20 cadavers. The cricothyroid membrane was identified. The kit's knife with its sharp-pointed edge cephalad was stabbed through the skin and cricothyroid membrane to create a midline longitudinal incision. The 27-cm (10-inch) slightly curved plastic guide was inserted through the incision and maneuvered, with digital guidance, into the oropharynx and out through the mouth, leaving 4–5 cm protruding from the skin. The oral end was then used to thread the tube into the trachea. The introducer was withdrawn via the incision when the advancing tube pushed it caudally at the incision site. After removal of the introducer the tube was advanced to its correct position. The technique is visualized in Fig. 1.

Results

Investigation on cadavers

Twenty cadavers were intubated using this retrograde technique. All were successfully intubated on the first

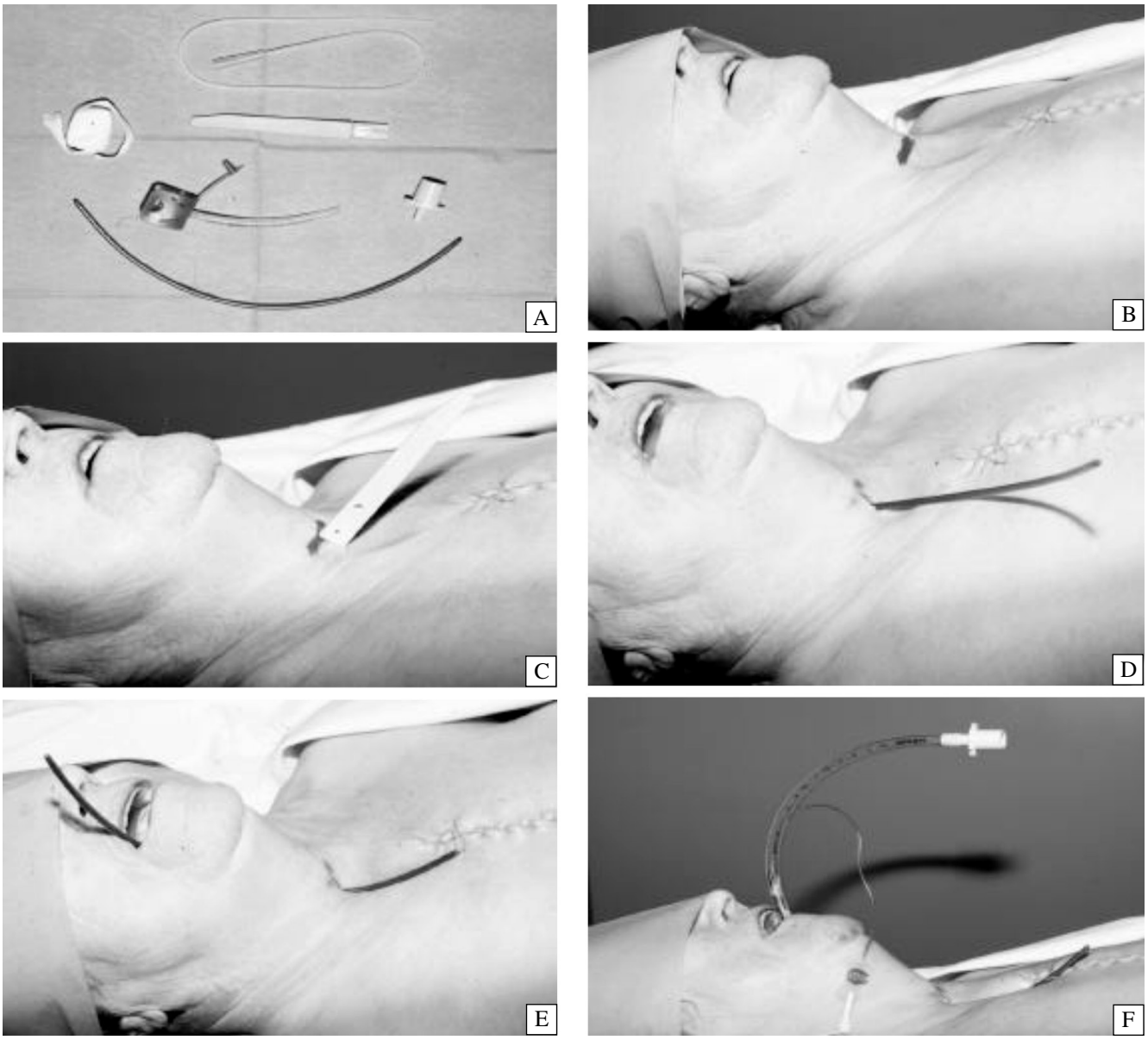

Fig. 1. (A) Mini-Trach II set. (B) Localization of the cricothyroid membrane. (C) Insertion of the knife. (D) Retrogade insertion of the guide (E) Guide in position. (F), Threading of the endotracheal tube.

attempt with a mean intubation time of 6.7 s (range 3–10) from incision to removal of the guide.

Clinical experiences

1 A 48-year woman had been on a ventilator in the intensive care unit for 9 days because of respiratory failure. After extubation the patient developed upper airway obstruction as a result of laryngeal edema. It was impossible to intubate with the conventional technique using a Macintosh laryngoscope (Heine, Munic, Germany). She eventually developed cardiac arrest. Retrograde intubation was performed and the patient was resuscitated without neurologic sequelae.
2 A 62-year woman was brought in to the emergency unit in cardiac arrest. Intubation was impossible because of gastric contents in the upper airway and a malfunctioning suction device. Retrograde intubation was successfully performed, however, the cardiac arrest was irreversible.
3 A patient with advanced rheumatoid arthritis developed upper airway obstruction after a cervical spine fusion (Cloward) operation. The patient was fiberoptically intubated awake before induction, and then extubated uneventfully in the operating room. In the recovery room, however, she progressively developed a nearly complete

upper airway obstruction to the point that only with assisted mask ventilation with 100% O_2 was a maximum SaO_2 of 95% feasible. External inspection revealed that an expanding hematoma and edema on the right side of the neck was displacing the trachea anteriorly and to the left. Both conventional and fiberoptic intubations, alone and in combination, were unsuccessful. Physicians from the ear, nose and throat (ENT) department located the trachea with an s.c. injection needle and placed a Portex Mini-Trach, via which ventilation with a Servo 900c ventilator (Siemens, Solna, Sweden), adjusted to pressure-controlled ventilation, was possible but inadequate as a result of the narrow lumen of the mini-trach. Consequently, two anesthesiologists experienced in this type of patient care persisted fiberoptically, but remained unsuccessful. Thirty minutes later the introducer from the mini-trach set was inserted beside the mini-trach and directed in a retrograde manner out through the mouth. A 6.5 tube was then threaded over this and inserted in the trachea using a finger. The whole incident lasted approximately 1.5 h including <15 s for the retrograde intubation.

A 69-year-old man was scheduled for a laparotomy because of a perforated diverticulus of the sigmoid colon. Conventional intubation was unsuccessful as the epiglottis could not be sufficiently elevated with the Macintosh laryngoscope. Once the succinylcholine wore off and spontaneous ventilation resumed, fiberoptic intubation was attempted. The problem remained due to the epiglottis obstructing the aditus laryngis. Following this, retrograde intubation with the mini-trach set was successfully performed within 10 s. Three months later, the patient was re-operated on. Despite being informed of the previous intubation problem the responsible anesthesiologist proceeded first with direct laryngoscopy. After intubation attempts with the Macintosh laryngoscope followed by the fiberoptic bronchoscope it was finally decided to resort to retrograde intubation. Initial attempts with an epidural catheter failed. Finally, 20 min after the first attempt, using the guide wire from a central venous line, retrograde intubation was successful.

Discussion

In our study we found that retrograde intubation using the knife and introducer from the Mini-Trach II kit was fast (7 s) and without failure in all subjects. This method was considerably quicker than any other described method, including both direct and fiberoptic laryngoscopic techniques, reported to take up to 30 and 50 s, respectively (8). In trauma patients, retrograde intubation using a guide wire could be accomplished within 5 min (9). So far, retrograde intubation using the Mini-Trach II kit has only been used in four patients, however, in all four it proved to be superior to more conventional methods and in one, life saving. It should be noted that complications after retrograde intubation, including bleeding, pneumothorax and perforation of the esophagus, have been described (10, 11) making it an inappropriate first choice in the management of a difficult airway. This is clearly indicated in the ASA algorithm (4). As no written guidelines exist in our department, the ASA algorithm (4) has been adapted to cope with such circumstances.

In emergency airway situations a fast establishment of a tracheal airway in an organized and systematic manner is vital, as under the strain of the circumstances it can be more difficult to obtain (12). This is especially true if the anatomy is distorted or the upper airway is filled with blood or gastric contents etc. Equipment and techniques have been developed to manage these situations in an anterograde manner (13–16). On the other hand, when these fail, are contraindicated or are not available and time is limited, more invasive procedures like retrograde intubation or cricothyroidotomy are necessary.

According to the ASA algorithm, fiberoptic intubation is a potential alternative in the management of a difficult airway (4). However, to ensure a high likelihood of success the anesthesiologist requires a clear field of view and sufficient time to safely accomplish the intubation. Optimally then, the patient should be spontaneously breathing (17). Furthermore, many anesthetic departments still do not have a fiberoptic bronchoscope and/or adequately trained personnel for its usage (18). Also, in rare cases, even with the fiberoptic technique, it is impossible to intubate (19, 20).

Earlier descriptions of retrograde intubation mainly suggest using equipment readily available to the anesthesiologist such as an epidural catheter or guide wire. Even though these have both been successfully used for retrograde intubation (5–7) it is our experience that because of their lack of rigidity, difficulty may be experienced either in correct positioning or in using them as a guide for the tube. Using the stiff curved plastic introducer included in the Mini-Trach II kit, with its design specifically intended for the placement of a mini-tracheostomi tube, we noted no problems in either of these maneuvers. Another

design of the introducer however, might further ease the retrograde technique and/or diminish the potential risk for complications such as the perforation or damaging of adjacent tissues.

In conclusion, retrograde intubation with the Mini-Trach II kit was fast, easy and reliable in cadavers. In specific cases it was proven to be superior to direct laryngoscopy and fiberoptic intubation, and life saving in one case. The technique is independent of other installations and has a potential advantage in suspected or manifested cervical spine injury.

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